

Influence of dietary and lifestyle factors on blood pressure control among adult hypertensive patients under care in Uganda

Patience Annet Nakalega

Victoria University

Levicatus Mugenyi

Makerere University

Lilian Nuwabaine

Makerere University

Mathius Amperiize (✉ mathius166@gmail.com)

Makerere University <https://orcid.org/0000-0002-4104-4830>

Barbara Kirunda Tabusibwa

Makerere University

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Abstract

Background Hypertension is an important worldwide public-health challenge because of its high prevalence and for being a risk factor for cerebrovascular, cardiovascular and chronic renal disease. Despite these risk factors, blood pressure control among hypertensive patients is still poor.

Objectives To assess dietary and lifestyle factors associated with uncontrolled blood pressure control among a series of Ugandan hypertensive patients under care at a Kiruddu hospital.

Methods A cross sectional study involving 271 adult hypertensive patients attending general outpatient hypertensive clinic were enrolled. We collected data on dietary and lifestyle factors, social demographics, BMI, comorbidities, and adherence to hypertensive medication. Dietary factors were based on recommended DASH diet including nine food items salt; grains; fruits; vegetables; nut/seeds, and legumes; dairy; meat; fat; and sweets. Questionnaires on alcohol intake, smoking status and level of physical activity were also administered. An average of the previous two Blood pressure readings were recorded while weight and height were measured for each subject at enrolment. Factors associated with uncontrolled blood pressure (>140/90mmHg) were assessed using a multivariate logistic regression model.

Results The mean age of study participants was 57 years (SD \pm 0.76 years), with female dominance (77.9%). Among the study participants, 121 (44.7%) had uncontrolled BP. Dietary factors that remained significantly associated with uncontrolled blood pressure with adjusted OR (95%CI) included consumption of raw salt: 4.18 (1.32-13.24) and inadequate fruit consumption (less than 7days/week): 2.18 (1.26-3.75) while clinical factors included being overweight: 2.51 (1.27-4.95) and poor adherence to antihypertensive medications prescribed: 1.82 (1.03-3.21).

Conclusion The proportion of hypertensive patients with uncontrolled BP was high (44.7%). Consumption of raw salt, inadequate fruit consumption being overweight and poor adherence to antihypertensive medication were significantly associated with uncontrolled BP. From these findings, many of the factors that impact on the control of blood pressure are fortunately modifiable.

Introduction

Hypertension is an important worldwide public-health challenge because of its high prevalence and a major risk factor for stroke, ischemic heart disease, congestive heart failure, myocardial infarction, and renal failure among others ([Mendis et al., 2005](#)). According to WHO, there are 1.39 billion people living with hypertension representing 31% of the global adult population (1). It is projected that the number of hypertension cases in Sub-Saharan Africa is approximately 80million representing 46% of the world's hypertensive population and this is estimated to increase to 150 million in 2025 (1). In Uganda, the findings from the National Non-Communicable Diseases Risk Factor Survey have shown an overall prevalence of hypertension of 26.4% ([Guwatudde et al., 2015](#)). Control of hypertension still remains minimal in the world despite the existence of clinical guidelines recommended from several trials which

dictate; following medication, dietary and exercise regimens, smoking cessation and minimizing alcohol consumption (2, 3). Uncontrolled BP accounts for 9.4 million deaths and is responsible for morbidity associated with approximately 54% of strokes, 47% of ischemic heart disease, 25% of other cardiovascular diseases and 7% of global disability-adjusted life years and nearly 10 million deaths per year (4).

Four behavioral risk factors play an important role in the development of hypertension. These include tobacco use, unhealthy diet, physical inactivity and harmful use of alcohol. Other risk factors of hypertension in adults include poor stress management, obesity and having diabetes mellitus (WHO 2013). The main objective in the management of hypertension is to attain an optimal BP to avert morbidities and mortalities associated with raised BP.

Lack of good BP control in more than two-thirds of people living with hypertension has been attributed mainly to poor compliance to therapy including dietary and lifestyle modification. There are limited data on the prevalence of BP control yet populations could benefit from control efforts (5).

Given that populations in low and middle countries are especially being affected through engagement in easily modifiable risk factors like unhealthy diet, tobacco use, harmful use of alcohol and physical inactivity, this study therefore aimed at quantifying the proportion of patients who had uncontrolled blood pressure and to identify dietary, lifestyle and clinical factors associated with BP control among hypertensive patients under care at Kiruddu hospital.

Materials And Methods

Ethical permission

Ethical clearance was sought from higher Degrees Research and Ethics Committees of Makerere University prior to implementation of the research study. Then permission was sought from Mulago hospital IRB and Kiruddu hospital. Written informed consent was obtained from all study participants before enrollment into the study.

Study design

The study employed descriptive cross-sectional design.

Study site

The study was conducted at the outpatient hypertensive clinic of Kiruddu general referral hospital an extension of Mulago National Referral Hospital located in Kampala, the capital city of Uganda. The site was chosen because it receives high number of patients diagnosed with hypertension from different

dispensaries, health centers and hospitals all over the country. This outpatient clinic sees approximately 100 individuals with hypertension per week.

Recruitment of study participants

Participants were eligible if they were 18 years or older with known diagnosis of hypertension

presenting at Kiruddu hypertensive outpatient clinic at least for the second time at the time of the study. Participants were excluded if their data of previous BP readings were not available. Participants who met the eligibility criteria represented the target study population. Consecutive sampling was used as participants were recruited as they came for each clinic day until the required sample size was achieved.

Study Variables

Trained Research Assistants collected data on dietary and lifestyle factors, social demographics and clinical factors. Social demographic information included age, gender, marital status, education attainment and occupation. Dietary patterns of the study participants were assessed basing on the recommended DASH diet using food frequency questionnaire of the foods consumed in the last one month including salt; grains; fruits; vegetables; nut/seeds, and legumes; dairy; meat; fat; and sweets. (6). Clinical factors assessed included Body mass index, comorbidities, and adherence to hypertensive medication. Adherence was assessed using the Morisky adherence scale (MMAS-8). It is an eight-question scale with Yes=0 or No=1 answers where a score of ≥ 6 is termed as good adherence while a score of < 6 is termed as poor adherence. (7).

Study participants were also interviewed on their lifestyle behaviors such as alcohol use, cigarette smoking, and level of physical activities. Alcohol consumption was defined as 'drinker' and 'non-drinker'. Quantity of alcohol consumed by current drinkers was classified according to how many bottles they drink per week in the past month. Greater than 2 standard drinks for men or greater than 1 drink for woman of local alcohol or imported alcoholic beverages per day (1 standard drink is equal to 14 grams of pure alcohol found in 1 regular beer) (8). Cigarette smoking status was defined as never, former, or current smoker. current smokers were those who were currently smoking while former smokers were those who had ever smoked in the last five years but were no longer smoking. Smoking was classified as taking any form and number of cigarettes.

Physical activity was assessed by asking participants if they are involved in either vigorous exercise (lifting heavy loads, digging, construction work), moderate exercise (brisk walking, carrying light loads, riding a bicycle and recreational activities like physical exercises and walking during leisure) or no exercise. Participants who spent at least 30 minutes/day of moderate-intensity activities 5 days a week and those who spent at least 10 minutes/ day of vigorous physical activities 5 days a week fulfilled WHO

minimum recommendations for physical activity (9). Those who did not meet the above criteria were classified as those with no exercise.

Current Blood pressure measurements were performed by trained study nurses following a standardized study protocol. Each study participant rested for at least 5 minutes prior to blood pressure measurements while sitting in a chair with both feet flat on the floor. Both arms were supported at the level of the heart on a table. To ascertain blood pressure control, we undertook document review of patient's files and recorded two recent BP readings measured in the previous four months. The average of the previous and current BP reading was used as the overall BP reading.

Anthropometric evaluations including measurement of weight and height were performed by Study nurses. Weight was measured using a pre-calibrated Secca scale with participants wearing light clothing and barefooted. Weight was rounded off to the nearest 1kg. Height was measured with the participant standing upright against a wall using a previously affixed height measuring device. Body mass index (BMI) of each participant was then derived by dividing weight in kilograms with height in meters squared (kg/m^2). This was divided into four categories underweight $<18.5\text{kg}/\text{m}^2$, Normal weight $18.5\text{-}24.99\text{kg}/\text{m}^2$, Overweight $25\text{-}29.99\text{kg}/\text{m}^2$ and Obese $\geq 30\text{kg}/\text{m}^2$ (10).

Results

Background characteristics of study participants

Overall, 271 respondents participated in the study. Their mean age was 57 (SD = 0.76) years which ranged from 22 to 86 years. Most of the respondents were females 211 (77.9%), 145 (53.5%) were currently married and 103 (38.0%) identified themselves as Catholics. As shown in **Table 1**, about 43% (117) were unemployed, 127 (46.9%) attained at least secondary level education and close to three-quarters (75.7%) were urban dwellers. Eighty-three (30.6%) of the respondents had been diagnosed with hypertension for more than 10 years while only 48 (17.7%) had the disease for less than two years.

Social demographic characteristics of participants with uncontrolled versus controlled BP

The mean systolic and diastolic BP readings were 146.0mmHg (95% CI: 142.0, 149.0) and 66.4mmHg (95% CI: 99.8, 135.2) respectively. The overall proportion of uncontrolled BP was 44.7% (95% CI: 38.7, 50.6%). There was no statistically significant difference between uncontrolled and controlled BP in terms of sex, age, marital status, religion, rural residence, level of education, employment status and duration with hypertension as shown in Table 1.

However, participants whose blood pressure were not controlled were more likely to reside in rural dwellings and have no formal education.

Table 1. Social demographic characteristics of participants with uncontrolled BP versus controlled BP

Back ground factors	Frequency (%) N=271	Blood pressure control		Odds ratio (CI)	p-value
		Uncontrolled BP n (%)	Controlled BP n (%)		
Sex					
Male	60 (22.1)	35 (23.3)	25 (20.7)	reference	
Female	211 (77.9)	115 (76.7)	96 (79.3)	0.86 (0.48-1.52)	0.598
Age					
≤34years	10 (3.7)	5 (3.3)	5 (4.1)	reference	
35-44 years	38 (14.0)	18 (12.0)	20 (16.5)	0.90 (0.22-3.62)	0.882
45-54 years	55 (20.3)	30 (20.0)	25 (20.7)	1.20 (0.31-4.62)	0.791
55-64 years	100 (36.9)	55 (36.7)	45 (37.2)	1.22 (0.33-4.49)	0.762
65 and above	68 (25.1)	42 (28.0)	26 (21.5)	1.62 (0.43-6.12)	0.481
Marital Status					
Single	11 (4.1)	6 (4.0)	5 (4.1)	reference	
Married	145 (53.5)	81 (54.0)	64 (52.9)	1.05 (0.31-3.61)	0.932
Divorced/Separated	70 (25.8)	40 (26.7)	30 (24.8)	1.11 (0.31-3.99)	0.872
Widowed	45 (16.6)	23 (15.3)	22 (18.2)	0.87 (0.23-3.27)	0.838
Residence					
Urban	205 (75.6)	118 (78.7)	87 (71.9)	reference	
Rural	66 (24.4)	32 (21.3)	34 (28.1)	0.69 (0.40-1.21)	0.198*
Religion					
Catholic	103 (38.0)	53 (35.3)	50 (41.3)	0.13 (0.02-1.10)	
Anglican	83 (30.6)	42 (28.0)	41 (33.9)		

Muslims	52 (19.2)	29 (19.3)	23 (19.0)	0.13 (0.02-1.07)	0.054*
Pentecostal	24 (8.9)	18 (12.0)	6 (5.0)	0.16 (0.02-1.35)	
Others	9 (3.3)	8 (5.33)	1 (0.8)	0.38 (0.04-3.65)	
				reference	
Employment Status					
Employment					
Unemployed	154 (56.8)	82 (54.67)	72 (59.50)	reference	
	117 (43.2)	68 (45.33)	49 (40.50)	1.22 (0.75-1.98)	0.424
Level of Education					
No formal	75 (27.7)	50 (33.3)	25 (20.7)	reference	
Primary level	69 (25.5)	34 (22.7)	35 (28.9)	0.49 (0.25-0.95)	
Secondary level	54 (19.9)	31 (20.7)	23 (19.0)	0.67 (0.33-1.39)	
Tertiary	73 (26.9)	35 (23.3)	38 (31.4)	0.46 (0.24-0.89)	0.085*
Duration with hypertension					
< 2years	48 (17.7)	26 (17.4)	22 (18.2)	reference	
2- < 5 years	68 (25.1)	38 (25.5)	30 (24.0)	1.11 (0.53-2.34)	0.989
5-10 years	72 (26.6)	40 (26.9)	32 (26.4)	1.06 (0.51-2.20)	
More than 10years	83 (30.6)	45 (30.2)	38 (31.4)	1.00 (0.49-2.04)	

Dietary and lifestyle habits of respondents

Table 2 shows the dietary habits of respondents. Out of 271 participants, 243 (89.7%) did not add raw salt to their cooked food, 117 (43.2%) and 118 (43.5%) were eating fruits and vegetables on most days of

the week respectively. One hundred thirteen (41.9%) of the respondents did not take dairy products at all, only 15 (5.5%) and 14 (5.2%) had not consumed nuts and grains respectively.

One hundred one (37.3%) of the respondents consumed fish at least once every week and only 4 (1.5%) consumed it every day. Fifty-three (19.6%) reported not to eat meat while about half of the respondents ate meat at least once every week (51.0%). One hundred fifty-three (56.0%) take sugar every day and 96 (35.4%) use vegetable oil while 101 (37.8%) use animal oil every day.

Only two participants (0.7%) were current smokers, and 45 (16.6%) reported that they drink alcohol on a daily basis. Over half of the patients (56.1%) were classified as having moderate levels of physical activity.

Dietary and lifestyle habits of participants with uncontrolled BP versus controlled BP

There was a higher proportion of participants who consumed raw salt in the uncontrolled BP group (16.0%) compared to only 4% in the controlled BP group. The odds of having uncontrolled BP was 5.57 among participants who consumed raw salt compared to those who did not ($p=0.002$). Similarly, there was a higher proportion of participants who did not consume fruits (64.7%) and vegetables (63.3%) every day in the uncontrolled group compared to the controlled BP group (43.0% and 46.3%) respectively. Inadequate consumption of fruits and vegetables had twice the odds of uncontrolled BP compared to adequate consumption ($p=0.000$ and $p=0.005$) respectively. Also, participants who consumed fish less than two servings a week were more likely to have uncontrolled BP ($p=0.014$). Participants who consumed red meat in a week were more likely to have uncontrolled BP as compared to those who did not, though the differences were not statistically significant ($p=0.137$).

Among the lifestyle habits of participants, smoking and inadequate physical activity were associated with uncontrolled BP while alcohol consumption had no association with BP control status. The categories “formerly smoked” and “current smoker” were merged due to low frequencies ($n=14$ and $n=2$, respectively) and this category was found to be associated with uncontrolled BP ($p=0.044$). There were higher percentages of no physical activity in the uncontrolled BP group (6.0%) compared to the controlled BP group (48.8%). Inadequate physical activity had 1.7 odds of uncontrolled BP compared to adequate physical activity and the difference between these groups was statistically significant ($p=0.030$). See Table 2.

Table 2: Dietary and lifestyle habits of participants with uncontrolled BP versus controlled BP

Diet and lifestyle	n (%)	Blood pressure control		Odds ratio (CI)	p-value
		Uncontrolled BP n (%)	Controlled BP n (%)		
Raw salt					
No intake	243 (89.7)	126 (84.0)	117 (96.7)	reference	
Raw salt Intake	28 (10.3)	24 (16.0)	4 (3.3)	5.57 (1.88-16.54)	0.002*
Fruits					
Everyday	122 (45.0)	53 (35.3)	69 (57.0)	reference	
<7days/week	149 (55.0)	97 (64.7)	52 (43.0)	2.43 (1.49-3.97)	0.000*
Vegetables					
Every day	120 (44.3)	55 (36.7)	65 (53.7)	reference	
<7days/week	151 (55.7)	95 (63.3)	56 (46.3)	2.00 (1.23-3.27)	0.005*
Dairy products					
≤1 cup of milk/day	232 (85.6)	126 (84.0)	106 (87.6)	reference	
> 1 cup of milk/day	39 (14.4)	24 (16.0)	15 (12.4)	1.35 (0.67-2.7)	0.402
Nuts/ Seeds					
4-5 serving/week	252 (93.0)	139 (92.7)	113 (93.4)	reference	
<4serving/week	19 (7.0)	11 (7.3)	8 (6.6)	1.12 (0.43-2.87)	0.817
Grains					
4-5servings/day	256 (94.5)	140 (93.3)	116 (95.9)	1.66 (0.55-4.99)	0.369
<4 serving/day	15 (5.6)	10 (6.7)	5 (4.1)	reference	
Fish/poultry					
≥2serving/week	110 (40.6)	51 (34.0)	59 (48.8)	reference	

<2 serving/week	161 (59.4)	99 (66.0)	62 (51.2)	1.85 (1.13- 3.02)	0.014*
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Diet and lifestyle	n (%)	Blood pressure control		Odds ratio (CI)	p-value
		Uncontrolled BP n (%)	Controlled BP n (%)		
Red meat					
Do not take red meat	88 (32.5)	43 (28.7)	45 (37.2)	reference	
Consume red meat	183 (67.5)	107 (71.3)	76 (62.8)	1.47 (0.88-2.46)	0.137*
Vegetable oil					
Daily serving	102 (37.6)	53 (35.3)	49 (40.5)	reference	
Once in a while	169 (62.4)	97 (64.7)	72 (59.5)	0.80 (0.49-1.32)	0.383
Animal oil					
Do not use	168 (62.0)	88 (58.7)	80 (66.1)	reference	
Use animal oil	103 (38.0)	62 (41.3)	41 (33.9)	0.73 (0.44-1.20)	0.210
Smoking					
Never smoked	255 (94.1)	137 (91.3)	118 (97.5)	reference	
Ever smoked	16 (5.9)	13 (8.7)	3 (2.5)	3.73 (1.04-13.41)	0.044*
Alcohol intake					
Non- alcohol use	222 (81.9)	122 (81.3)	100 (82.6)	reference	
Alcohol use	49 (18.1)	28 (18.7)	21 (17.4)	1.09 (0.59-2.04)	0.780
Physical activity					
Ad. physical activity	119 (43.9)	57 (38.0)	62 (51.2)	Reference	
No physical activity (56.1)	152	93(62.0)	59(48.8)	1.71(1.06-2.88)	0.030*

Clinical characteristics of study participants

Eight (3.0%) of the respondents were underweight, 89 (32.8%) were of normal weight while the rest (64.2%) were either overweight or obese. Over half (62.4%) of the patients were classified as having good adherence to prescribed hypertensive medications.

Of all the respondents, 82 (30.3%), 98 (36.2%), 35 (12.9%) had heart problems, diabetes mellitus, and other diseases (like kidney diseases) respectively which may be related to high percentage of participants having hypertension for more than 10 years. Ninety-one (33.6%) of the respondents did not have any known comorbidity.

Clinical characteristics of participants with uncontrolled BP versus controlled BP

There was a higher proportion of overweight participants in the uncontrolled BP group (38.6%) compared to the controlled group (23.1%) while the proportion of participants with normal body mass index in the controlled group was much higher (38.8%) than in the uncontrolled group (28.0%). Overweight had twice the odds of uncontrolled BP compared to normal weight and the difference between these groups was statistically significant ($p=0.007$).

Study participants with good adherence were more likely to have controlled BP levels (74.4% of patients with controlled blood pressure had good adherence levels). The odds of having uncontrolled BP among poor adherent participants were 2.61 compared to those who were fully adherent ($p<0.000$).

Slightly higher percentages of participants in the uncontrolled BP group had heart problems and diabetes (32.0%), (37.0%), compared to those in the controlled group (28.1%), (34.7%) respectively. However, the differences found between these groups were not statistically significant. Table 3

Table 3: Clinical characteristics by blood pressure control status

Factor	Frequency (%)	Blood pressure control		Odds ratio (CI)	p-value
		Uncontrolled BP n (%)	Controlled BP n (%)		
BMI					
Underweight	8 (3.0)	2 (1.3)	6 (5.0)	0.37 (0.71-1.95)	0.242
Normal weight	89 (32.8)	42 (28.0)	47 (38.8)	reference	
Over weight	86 (31.7)	58 (38.6)	28 (23.1)	2.32 (1.25-4.28)	0.007*
Obese	88 (32.5)	48 (32.0)	40 (33.1)	1.34 (0.74-2.42)	0.328
Adherence to hypertensive drugs					
Adherence					
Non- adherence	169 (62.4)	79 (52.67)	90 (74.4)	reference	
	102 (37.6)	71 (47.33)	31 (25.62)	2.61 (1.55-4.38)	0.000*
Co-morbidities					
Heart problems	82 (30.3)	48 (32.00)	34 (28.1)	1.29 (0.66-2.52)	0.465
Diabetes	98 (36.2)	56 (37.3)	42 (34.7)	1.09 (0.48-2.03)	0.666
Other diseases	35 (12.9)	17 (11.3)	14 (11.6)	0.92 (0.41-2.47)	0.840
No comorbidity	91 (33.6)	48 (32.0)	43 (35.5)	reference	

Statistically significant variables at p<0.05

Factors associated with blood pressure control among hypertensive patients

Table 4 presents the adjusted estimates of the demographic, dietary, lifestyle and clinical characteristics of the respondents with their unadjusted estimates. Among the dietary factors, participants who consumed raw salt were 4.18 times more likely to have uncontrolled BP (adjusted odds ratio (AOR) =4.18,

95% CI: 1.32-13.24, $p=0.015$) as compared to those who did not. Similarly, participants who failed to consume fruits everyday were 2.18 more like to have uncontrolled BP compared to those who consumed fruits every day (AOR=2.18, 95% CI: 1.26-3.75, $p=0.005$). Among the clinical factors, participants who were overweight were 2.51 times more likely to have uncontrolled BP compared to their counterpart who were either underweight or had a normal body weight (AOR=2.52, 95% CI: 1.27-4.95, $p=0.008$). There was a positive association between being obese and having uncontrolled BP however this difference was not statistically significant ($p=0.192$). Similarly, participants who did not adhere to their anti-hypertensive medication were 1.82 times more likely to have uncontrolled BP compared to those who adhered to their medication (AOR=1.82, 95% CI: 1.03-3.21, $p=0.039$). Although religion, place of residence, level of education, eating vegetables less than 7 days/week, consumption of fish less than two serving a week, consumption of red meat every week, smoking and inadequate physical activity was strongly associated with blood pressure control in unadjusted analysis, the effects were moderated into non-significance in adjusted analysis.

Table 4: Factors associated with blood pressure control among hypertensive patients

Factors	Un adjusted OR (95%CI)	Adjusted OR (95% CI)	p value
Residence			
Urban	reference		
Rural	0.69 (0.40-1.21)		
Religion			
Catholic	0.13 (0.02-1.10)	0.13 (0.01-1.13)	0.064
Anglican	0.13 (0.02-1.07)	0.13 (0.01-1.20)	0.072
Muslim	0.16 (0.02-1.35)	0.12 (0.01-1.15)	0.067
Pentecostal	0.38 (0.04-3.65)	0.33 (0.03-0.48)	0.354
Others	reference		
Raw salt			
No intake	reference		
Intake of raw salt	5.57 (1.88-16.54)	4.18 (1.32-13.24)	0.015*
Fruit intake			
Everyday	reference		
<7days/week	2.43 (1.49-3.97)	2.18 (1.26-3.75)	0.005*
Smoking			
Never smoked	reference		
Ever smoked	3.73 (1.04-13.41)	3.73 (0.95-14.67)	0.059
BMI			
Underweight	0.37 (0.07-1.95)	0.47 (0.07-3.05)	0.431
Normal weight	reference		
Over weight	2.32 (1.25-4.28)	2.51 (1.27-4.95)	0.008*
Obese	1.34 (0.74-2.42)	1.54 (0.80-2.95)	0.192
Adherence to drugs			
Adherence	reference		
Non-adherence	2.61 (1.55-4.38)	1.82 (1.03-3.21)	0.039*

Discussion

The results showed that almost half of the participants had uncontrolled BP (44.7%) The dietary and lifestyle factors associated with this problem were consumption of raw salt, and inadequate fruit intake while clinical factors included being overweight and non-adherence to prescribed antihypertensive medication.

Controlling BP in people with hypertension to reduce cardiovascular morbidity and mortality is a major challenge and a public health problem in many developing countries including Uganda. This study revealed that 44.7% of hypertensive patients had uncontrolled BP despite being on follow up and under care at Kiruddu hospital. This finding coincides with studies in Ethiopia (42.9%) and France (47%) where high levels of uncontrolled BP were reported (11, 12). However, this study had a much higher prevalence than that seen in a Korean study of 15.6% (13).

Despite the high prevalence seen in this study, some studies in other countries like Ethiopia (52.7%), Ghana (57.7%) and Singapore (75.9%) had a much higher uncontrolled BP percentage. (14-17). This might be due to the difference in the study population (community vs hospital-based study, elderly vs general population) and lifestyle behaviors such as feeding habits and sedentary lifestyles that bring hypertension difficult to control.

Another study conducted in central Kenya among hypertensive patients indicated that the level of poor BP control was as high as 66.4% compared to the finding of this research, and this could be because single BP measurements were taken in Kenya in contrast to this study which may have led to overestimated prevalence (18).

Although no associations were found for social demographic characteristics such as sex, age and employment status in this study, some previous studies have identified a relationship between these factors and having uncontrolled BP (5, 19-21). Studies have reported an association between increasing age and uncontrolled BP (22), while a study by Teshome DF et al., showed that hypertensive patients older than 60 years were three times more likely to control their BP as compared to the age group of 18-40 years (11). These results could be due to different age categorization, and the high percentages of females (77.9%) in this study suggesting possible gender differences in health seeking behaviors.

Similar to our study, age was not associated with uncontrolled BP in a study by Basu and Millett (23).

Rural residence and level of education were not significant in this study. However, in the Prospective Urban Rural Epidemiology (PURE) study, better BP control was seen among urban than rural dwellers (24) while in a Ghanaian study, higher rates of uncontrolled BP were seen among urban than rural residents (14).

Dietary factors associated with uncontrolled BP in this study included: inadequate fruit consumption and raw salt consumption. These results are similar to those from a previous study in Ethiopia where the use of top added salt on a plate and failure to consume fruits and vegetables on most

days of the week were negatively associated with optimal BP control (11). This may be because high salt intake causes fluid retention which increases cardiac burden resulting in high BP.

Despite some studies finding an association with some lifestyle factors, this study did not find any association with smoking, physical activity and alcohol intake. Increased physical activity was associated with successful BP control in a Korean and Ethiopian studies (11, 13). This difference may be due to the low numbers of participants who reported to be current smokers (0.7%).

Overweight and obesity were common among our study subjects (31.7% and 32.5% respectively). This study showed that BP control is poor in overweight patients. Indeed, our finding supports the notion that persistent overweight and obesity can interfere with the efficacy of hypertension drugs, increase peripheral vascular resistance which increases cholesterol and triglyceride levels and decreases HDL levels in the blood, and thereby exacerbate poor BP control (25). This finding is coherent with similar studies in Singapore, Angola and Uganda (26-28) but BMI had no association in a Nigerian study (17, 28).

Poor adherence to prescribed anti-hypertensive medication captured by the Morisky Medication Adherence Scale was a key determinant of BP control as expected. This finding is in line with that of previous studies in Ghana and Ethiopia (11, 14). Reasons for non-adherence are multi-factorial and are often contributed to by a mix of patient related, physician related and health system-related factors. This makes adherence to therapy for chronic diseases such as hypertension a major challenge worldwide (Brown and Bussell 2010).

Clinical variables that did not show any association with BP control contrary to other studies included duration with hypertension, number of comorbidities, and presence of diabetes. In a study by Myung Hwa Yang et al., patients with comorbidities and high numbers of comorbid diseases showed better BP control achievement rates (13). This difference may be attributed to the use of either patient files or self-reported methods to ascertain if a patient had any other diseases.

Conclusions

- The proportion of hypertensive patients with uncontrolled BP among this study population was high (44.7%).
- Dietary factors including consumption of raw salt and inadequate fruit consumption were significantly associated with uncontrolled BP.
- Overweight and poor adherence to antihypertensive medication were the clinical factors significantly associated with uncontrolled BP.
- As identified in this study, many of the factors that impact on the control of blood pressure are fortunately modifiable. Researchers should use objective methods to assess dietary habits in order to avoid under or over reporting. In addition, further longitudinal studies that include physical and biochemical measurements to identify variables associated with uncontrolled BP should be carried out.

- Further investigation is warranted to assess health professional level of knowledge on hypertension management. There is also a need to explore other factors that have been shown to have an association with BP control status like health system related factors ([Brown and Bussell 2010](#)).

Declarations

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Competing interests

The Authors have no competing interests

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